REMARKS

This Response is submitted in reply to the Office Action dated November 1, 2005, in which the Examiner:

- rejected claims 1-17, 19-22, 25 and 27-30 under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 5,833,369 to Heshmat; and
- rejected claims 16-30 under 35 U.S.C. § 103(a) as being unpatentable over Heshmat.

Claims 1, 8, 9, 15 and 25 have been amended. Claims 7, 10 and 16 have been cancelled. Claims 2-6, 11-14, 17-24 and 26-30 remain for consideration as originally filed.

Applicant's Arguments with Respect to the Rejections

The present application is generally directed to a compliant foil thrust bearing capable of handling a high load capacity. Load capacity of a foil thrust bearing is dependent on the flatness of the bearing – as flatness is maximized, load capacity increases. Prior art bearings make use of solid base plates (such as thrust plate 41 described in Heshmat), to which top foils and/or springs may be mounted. Due to the manufacturing process of such solid base plates, the plates are not truly flat. For example, warpage or distortion may be introduced during the heat-treating process or due to uneven cooling. When mounted and in operation, the plates cannot be kept parallel to the thrust runner. As a result, the bearing wobbles as an air/gas film forms between the runner and the bearing – much like a chair where all the legs don't sit flat on the floor at the same time. The wobble, however slight, is accentuated at higher speeds, potentially causing the bearing to skew and touch the thrust runner, and ultimately compromising the load capacity of the bearing. (See also Application, p. 3, ¶ 6).

A goal of the present invention is to improve the flatness of base plates used in the bearing. Specifically, lines of weakness are circumaxially dispersed on a base plate to define decoupled bearing segments that are likewise circumaxially dispersed about the base plate.[1] Such plates with lines of weakness

[1] The term "decoupled bearing segments" is used in each of the claims of the present application and should therefore be interpreted consistently for every claim. The Examiner's attempt to ascribe a specific shape to the "segments" is improper. (See Office

have greater utility where flatness of the plates is desired or likely to be a problem. As noted in the application, as filed,

> Flat plates ensure that the plates will remain essentially parallel to the thrust runner 12 over a range of operating environments as well as over a range of axial loads and thrusts. The decouplable aspect provided by the lines of weakness 40a and 42a allows the structure of the housing 16 and the thrust runner 12 to substantially maintain the flatness of the thrust bearing plate 28a and spring plate 32a in the thrust bearing 14a without warpage, distortion and scraping. (Application, p. 9, ¶ 28; see also p. 5, ¶ 15; p. 8, ¶ 25).

By contrast, U.S. Patent No. 5,833,369 to Heshmat, while directed to a "High Load Capacity Foil Hydrodynamic Thrust Bearing," addresses compliancy of the thrust bearing in a different manner from the present invention. A thrust runner 22, having a bearing surface 24 is fastened to a rotating shaft 20. A bearing 40 is positioned adjacent the surface 24, and includes a thrust bearing assembly 44 fastened to the top surface of a thrust plate 41. Every embodiment disclosed in Heshmat includes the backing thrust plate 41. (See also Heshmat, claims 1, 16 and 17 ("backing plate")). Essentially, the thrust plate 41 of Heshmat acts as the thrust bearing plate as described in the present application with resilient members disposed between the backing plate and smooth top sheets 42 so that the top sheets may suitably deflect under load to provide compliance with the thrust runner. In Heshmat's preferred embodiment, the thrust plate 41 is a flat, solid plate having all of the problems of prior art base plates discussed in the present application and above (e.g., warpage, distortion, wobble). Alternatively, Heshmat notes that the backing plate 41 may be concave, dished or conical, in which case, the concerns of the present application would not be addressed.

The Examiner's rejections of the claims of the present invention relies on the structure of the thrust bearing assembly 44 disclosed in Heshmat separate from the solid backing plate 41. As disclosed, the thrust bearing assembly 44 includes several layers, shown in detail in Figure 2, that are attached to the thrust plate 41. On the surface facing the thrust runner 22 is a circumferential row of

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Action, pp. 3-4 ("arced, pie-shaped segment")). The "segments" are clearly defined in the claims – i.e., "defined in part by a plurality of lines of weakness circumaxially dispersed about the . . . plate". While such segments may be "arced" and "pie-shaped" in accordance with preferred embodiments, the claims are not limited to such a narrow interpretation.

thin resilient top sheets 42. The top sheets are mounted on a flexible membrane 60, which, in turn, is supported on a pair of outer and inner circumferentially extending rows of corrugated compliant support elements 48 and 49. Sandwiched between the top sheets 42 and the flexible membrane 60 are resilient flat strips 80 that provide radial conformity. Beneath the corrugated compliant support elements 48 and 49 is a flexible diaphragm 62 having multiple resilient flat strips 66. Sandwiched between the flexible diaphragm 62 and the backing plate 41 is a circumferential row of corrugated resilient spring metal support elements 68.

The Examiner has interpreted the flexible membranes 60 and 62 to be a thrust bearing plate and a spring plate, respectively, with respect to the claimed invention of the present application. The Examiner has noted that Heshmat discloses the use of radially-spaced rows of circumferentially extending slots 74 in the flexible membrane 60 to improve radial compliance of the bearing. (See Heshmat, FIG. 5; col. 5, ll. 40-45). Additionally, the Examiner has noted that Heshmat discloses using radially-extending slots 92 in the flexible membrane to improve bearing compliance. (See Heshmat, FIGS. 7-8; col. 6, l. 67 to col. 7, l. 5).

As discussed below, the claims of the present application, as amended, are distinct from the foil thrust bearing disclosed and/or suggested by Heshmat such that the examiner's rejections should be withdrawn.

Claims 1-17, 19-22, 25 and 27-30 (35 U.S.C. § 102(b))

As noted, the Examiner has rejected claims 1-17, 19-22, 25 and 27-30 under §102(b) as anticipated by Heshmat. In order to anticipate a claim under § 102(b), each and every element of the claimed invention must be disclosed in a single patent reference. See Advanced Display Sys. Inc. v. Kent State Univ., 212 F.3d 1272, 1282, 54 U.S.P.Q.2d 1673, 1679 (Fed. Cir. 2000) ("[A]nticipation requires that the four corners of a single, prior art document describe every element of the claimed invention, either expressly or inherently, such that a person of ordinary skill in the art could practice the invention without undue experiment."). Absent the disclosure of any element of the claimed invention, any rejection pursuant to 35 U.S.C. § 102(b) based on the cited reference is improper.

In the Office Action, the Examiner admitted with respect to the obviousness rejection of claims 16-30 under § 103(a) that Heshmat does not disclose a thrust bearing plate having decoupled bearing segments defined in part by a plurality of lines of weakness. However, the Examiner has rejected, under § 102(b), several claims that include this element – namely, independent claims 17 and 25, as well as claims 7-8 and 16 (dependent on claim 1), 19-22 (dependent on claim 17) and 27-30 (dependent on claim 25). Inasmuch as the Examiner acknowledges that Heshmat fails to teach each and every limitation of claims 7-8, 16-17, 19-22, 25 and 27-30, the Examiner's § 102(b) rejection is improper.

To this end, Applicant has amended claim 1 of the present invention to comprise a thrust bearing plate including a plurality of decoupled bearing segments defined in part by a plurality of lines of weakness circumaxially dispersed about the thrust bearing plate. Claims 8, 9 and 15 have been amended and claims 7, 10 and 16 have been canceled to reflect the amendment of claim 1. (Claim 25 has been amended to correct a typographical error).

Accordingly, Applicant submits that the Examiner's rejection of the claims, as amended, under 35 U.S.C. § 102(b), is improper, and should be withdrawn.

Claims 16-30 (35 U.S.C. § 103(a))

The Examiner has also rejected claims 16-30 of the present invention under 35 U.S.C. § 103(a) based on a modification of Heshmat by the purported knowledge of one of ordinary skill in the art. Specifically, while the Examiner acknowledges that Heshmat fails to teach a thrust bearing plate having decoupled bearing segments defined in part by a plurality of lines of weakness, the Examiner asserts that one of ordinary skill in the art would exchange the design of the flexible diaphragm 62 in Heshmat for the flexible membrane 60. Even assuming that the flexible membrane 60 is a thrust bearing plate (as opposed to the thrust plate 41), Applicant submits that such modification relies on impermissible hindsight and moreover would alter the intended design of the Heshmat thrust bearing. Accordingly, Applicant submits that the Examiner

rejection under 35 U.S.C. § 103(a) is improperly supported and therefore should be withdrawn with respect to Applicants' claims, as amended and presented.

The test of obviousness must be taken at the time the invention is made, not as the invention would have been perceived during prosecution. The Examiner must look at the state of the art that existed at the time the invention was made and resist from relying on hindsight. See Sensonics, Inc. v. Aerosonic Corp., 81 F.3d 1566, 1570 (Fed. Cir. 1996). The Examiner must specifically identify some motivation, suggestion or teaching in cited prior art references regarding the desirability of modifying the prior art to meet the burden of an obviousness rejection. See Brown & Williamson Tobacco Corp. v. Philip Morris Inc., 229 F.3d 1120, 1124-25, 56 U.S.P.Q.2d 1456, 1459 (Fed. Cir. 2000). Common knowledge and common sense cannot be used to find an invention obvious over a modification of prior art references. See In re Lee, 277 F.3d 1338, 1343-44, 61 U.S.P.Q.2d 1430, 1434-35 (Fed. Cir. 2002). Since there is no teaching or suggestion whereby a person of ordinary skill would have been led to modify the prior art design to incorporate the characteristics of the present invention, and in so doing, alter the structure and operation of the Heshmat design, an obviousness rejection of the pending claims, as amended, is improper.

In Heshmat, flexible membrane 60 is an optional component. (See Heshmat, col. 4, ll. 50-52 ("The bearing 40 may be constructed without a flexible membrane 60, and the present invention is intended to cover such an embodiment.")). The membrane 60 is dispensable because of the presence of the thrust plate 41 as a backing member for the bearing sheets 42. In the embodiment shown, the membrane 60 is provided as support for the bearing sheets 42. The positioning of the sheets 42 with respect to the bearing surface 24 of the thrust runner 22 is adjusted by corrugated compliant support elements 48 and 49. (See Heshmat, col. 4, ll. 34-41). Additional support is provided by flexible diaphragm 62 and more resilient members 66 and 68. (See Heshmat, col. 5, ll. 1-11). Deflection of the bearing sheets 42 is provided by the resilient components. (See, e.g., Heshmat, col. 6, ll. 57-63).

The flexible membrane 60 of Heshmat, where included in the bearing design, is not described in terms of increasing load capacity by maintaining the flatness of the membrane. Instead, the flexible membrane is provided with

radially-spaced rows of circumferentially-extending slots 74. These slots 74 improve radial compliance of the bearing and enable it to accommodate excursions of the thrust runner as well as to enable cooling of the outer smooth sheets. (See Heshmat, col. 5, ll. 40-45). Heshmat defines "radially" as the direction toward or away from the central opening 23. (See Heshmat, col. 5, ll. 18-20; see also col. 5, ll. 64-67 (flat strips 80 to provide optimum radial conformity)). The flexibility added by such slots, therefore, permits varying deflection of the inner circumferential edge versus the outer circumferential edge, which would affect the desired flatness of the base plate, but still provide the radial compliance desired for the Heshmat invention. Thus, the problem addressed by the slots 74 is strictly radial compliance and not circumferential compliance or improving the flatness of the base plate. Indeed, the slots 74 do not define decoupled bearing segments, and the concerns of warping and distortion on the flexible membrane 60 are still present despite the inclusion of axially-extending slots 74.

To replace the slots 74 in the flexible membrane 60 with slots 92 as shown on the disclosed flexible diaphragm 62 would eliminate the radial compliance provided by the flexible membrane 60. As disclosed, the slots 92 extend radially and are spaced about the circumference of the diaphragm to improve the compliance of the bearing and enable the bearing to accommodate excursions of the thrust runner. (See Heshmat, col. 6, l. 67 to col. 7, l. 5). Notably, the patent does not state radial compliance is improved by the flexible diaphragm. Such compliance is expressly reserved for the design of the flexible membrane 60 (i.e., with radially-spaced slots as opposed to radially extending slots). Moreover, Heshmat expressly uses the term "diaphragm", which typically relates to a thin plate or partition that adds rigidity to a structure. Therefore, the varying slots designs are not mere alternatives and exchanging the design of the flexible diaphragm for the flexible membrane is not a simple matter. To do so would completely alter the intended structure and operation of the bearing disclosed by Heshmat, and therefore, a motivation to do so at the expense of the desired radial compliance provided by the original structure is required. Further, nothing in Heshmat provides any instruction that the flexible diaphragm can be used as a flexible membrane (i.e., for support of foils). Based on the Heshmat disclosure,

the only reason to replace the flexible membrane with the flexible diaphragm to have a thrust bearing plate with circumaxially dispersed lines of weakness defining decoupled bearing segments would be through hindsight with the benefit of Applicant's claims. Use of such hindsight to render a claim obvious is improper.

Accordingly, Applicant submits that the Examiner's rejection of the claims, as amended, under 35 U.S.C. § 103(a), is improper, and should be withdrawn.

Conclusion

For at least either of the above reasons, Applicant submits that the cited reference (Heshmat) does not disclose or suggest each and every limitation of the claims in the present application. Applicant respectfully submits that the rejection pursuant to 35 U.S.C. § 102(b) with respect to claims 1-17, 19-22, 25 and 27-30 is improper. Additionally, Applicant has noted above why the rejection of claims 16-30 pursuant to 35 U.S.C. § 103(a) is improper. Accordingly, Applicant submits that all the claims, including those amended herein, are allowable, and favorable reconsideration is respectfully requested.

Applicant hereby petitions for a one-month extension of time in order to file this response. The fee of $60.00 required under 37 CFR 1.17(a) is enclosed.

If any additional extension of time for the accompanying Response is required, Applicant requests that this paper be considered a petition therefor.

If any other fees are due, they may be charged to Deposit Account No. 13-0235.

Respectfully submitted,

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